CLAIMS

1. A method comprising:

transmitting a first training symbol on a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of the plurality of antennas transmits corresponding ones of the plurality of data symbols.

2. The method of claim 1, further comprising:

transmitting a second training symbol on the plurality of antennas,

wherein the second training symbol comprises the plurality of data symbols in the first training symbol, and

wherein each of the plurality of antennas transmits different ones of the plurality of data symbols than in the first training symbol.

3. The method of claim 2, wherein the first training symbol has a first pattern in which each of the plurality of antennas transmits one of a plurality of subsets of the plurality of data symbols, and

wherein the second training symbols has a second pattern comprising a shifted pattern of the first pattern such that each of the plurality of antennas transmits a different one of said plurality of subsets than in the first training symbol.

4. The method of claim 1, wherein the plurality of antennas comprises N antennas, and further comprising transmitting N-1 training symbols after the first training symbol.

5. The method of claim 4, further comprising:

transmitting each of said training symbols at least two times.

6. The method of claim 1, further comprising:

transmitting the first training symbol at least two times.

7. The method of claim 1, wherein the plurality of data symbols in the first training symbol are transmitted simultaneously on the plurality of antennas.

8. The method of claim 1, wherein each of the plurality of antennas transmits said corresponding ones of the plurality of data symbols on corresponding ones of the plurality of tones and transmits null symbols on the other tones.

9. The method of claim 1, wherein the first training symbol comprises an OFDM (Orthogonal Frequency Division Multiplexing) training symbol.

10. A method comprising:

receiving a first training symbol transmitted by a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of a plurality of subsets of the plurality of data symbols is received from a corresponding one of the plurality of antennas; and

in response to at least the first training symbol, determining a gain at each of the plurality of antennas for each of the plurality of tones.

11. The method of claim 10, wherein said determining comprises:

for each of the plurality of antennas, interpolating values for a plurality of said tones from the corresponding subset of the plurality of data symbols received from said antenna.

12. The method of claim 10, wherein said plurality of antennas comprises N antennas, and

further comprising:

receiving N-1 training symbols after the first training symbol.

13. The method of claim 12, wherein each of the first and N-1 training symbols comprises the plurality of data symbols, and

wherein each of said training symbols has a corresponding pattern in which a different subset of the plurality of data symbols is transmitted on each of said plurality of antennas than in the other training symbols.

14. The method of claim 13, further comprising:

receiving each of the plurality of data symbols from each of the plurality of antennas.

15. The method of claim 14, wherein said determining comprises:

performing an inverse Fourier transform on the plurality of data symbols received from each of the plurality of antennas.

16. A preamble structure comprising:

a first training symbol comprising a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of a plurality of subsets of the plurality of data symbols is designated to be transmitted by a corresponding one of a plurality of antennas.

17. The preamble structure of claim 16, wherein said plurality of antennas comprises N antennas, and wherein the preamble structure further comprises:

N-1 training symbols in addition to the first training symbol,

wherein each of said training symbols comprises the plurality of data symbols, and

wherein each of said training symbols has a corresponding pattern in which a different subset of the

plurality of data symbols is transmitted on each of said plurality of antennas than in the other training symbols.

18. The preamble structure of claim 17, wherein the preamble structure comprises a preamble structure for an N X N multiple-in-multiple-out (MIMO) system.

19. The preamble structure of claim 16, wherein the training symbols comprise Orthogonal Frequency Division Multiplexing (OFDM) training symbols.

20. An apparatus comprising:

a training module operative to transmit a first training symbol on a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of the plurality of antennas transmits corresponding ones of the plurality of data symbols.

21. The apparatus of claim 20, wherein the training module is further operative to transmit a second training symbol on the plurality of antennas,

wherein the second training symbol comprises the plurality of data symbols in the first training symbol, and

wherein each of the plurality of antennas transmits different ones of the plurality of data symbols than in the first training symbol.

22. The apparatus of claim 21, wherein the first training symbol has a first pattern in which each of the plurality of antennas transmits one of a plurality of subsets of the plurality of data symbols, and

wherein the second training symbols has a second pattern comprising a shifted pattern of the first pattern such that each of the plurality of antennas transmits a different one of said plurality of subsets than in the first training symbol.

23. The apparatus of claim 20, wherein the plurality of antennas comprises N antennas, and wherein the training module is further operative to transmit N-1 training symbols after the first training symbol.

24. The apparatus of claim 23, wherein the training module is further operative to transmit each of said training symbols at least two times.

25. The apparatus of claim 20, wherein the training module is further operative to transmit the first training symbol at least two times.

26. The apparatus of claim 20, wherein the training module is further operative to transmit the plurality of data symbols in the first training symbol simultaneously on the plurality of antennas.

27. The apparatus of claim 20, wherein for each of the plurality of antennas, the training module is further operative to transmit said corresponding ones of the plurality of data symbols on corresponding ones of the plurality of tones and transmit null symbols on the other tones.

28. The apparatus of claim 20, wherein the first training symbol comprises an OFDM (Orthogonal Frequency Division Multiplexing) training symbol.

29. A apparatus comprising:

a training module operative to receive a first training symbol transmitted by a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of a plurality of subsets of the plurality of data symbols is received from a corresponding one of the plurality of antennas, and

in response to at least the first training symbol, determine a gain at each of the plurality of antennas for each of the plurality of tones.

30. The apparatus of claim 29, wherein for each of the plurality of antennas, the training module is operative to interpolate values for a plurality of said tones from the corresponding subset of the plurality of data symbols received from said antenna.

31. The apparatus of claim 29, wherein said plurality of antennas comprises N antennas, and

wherein the training module is further operative to receive N-1 training symbols after the first training symbol.

32. The apparatus of claim 31, wherein each of the first and N-1 training symbols comprises the plurality of data symbols, and

wherein each of said training symbols has a corresponding pattern in which a different subset of the plurality of data symbols is transmitted on each of said plurality of antennas than in the other training symbols.

33. The apparatus of claim 32, wherein the training module is further operative to receive each of the plurality of data symbols from each of the plurality of antennas.

34. The apparatus of claim 33, wherein the training module is further operative to perform an inverse Fourier transform on the plurality of data symbols received from each of the plurality of antennas.

35. An apparatus comprising:

means for transmitting a first training symbol on a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of the plurality of antennas transmits corresponding ones of the plurality of data symbols.

36. The apparatus of claim 35, further comprising:

means for transmitting a second training symbol on the plurality of antennas,

wherein the second training symbol comprises the plurality of data symbols in the first training symbol, and

wherein each of the plurality of antennas transmits different ones of the plurality of data symbols than in the first training symbol.

37. The apparatus of claim 36, wherein the first training symbol has a first pattern in which each of the plurality of antennas transmits one of a plurality of subsets of the plurality of data symbols, and

wherein the second training symbols has a second pattern comprising a shifted pattern of the first pattern such that each of the plurality of antennas transmits a different one of said plurality of subsets than in the first training symbol.

38. The apparatus of claim 35, wherein the plurality of antennas comprises N antennas, and further comprising transmitting N-1 training symbols after the first training symbol.

39. The apparatus of claim 38, further comprising:

means for transmitting each of said training symbols at least two times.

40. The apparatus of claim 35, further comprising:

means for transmitting the first training symbol at least two times.

41. The apparatus of claim 35, wherein the plurality of data symbols in the first training symbol are transmitted simultaneously on the plurality of antennas.

42. The apparatus of claim 35, wherein each of the plurality of antennas transmits said corresponding ones of the plurality of data symbols on corresponding ones of the plurality of tones and transmits null symbols on the other tones.

43. The apparatus of claim 35, wherein the first training symbol comprises an OFDM (Orthogonal Frequency Division Multiplexing) training symbol.

44. A apparatus comprising:

means for receiving a first training symbol transmitted by a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of a plurality of subsets of the plurality of data symbols is received from a corresponding one of the plurality of antennas; and

means for determining a gain at each of the plurality of antennas for each of the plurality of tones in response to at least the first training symbol.

45. The apparatus of claim 44, wherein said means for determining comprises:

means for interpolating values for a plurality of said tones from the corresponding subset of the plurality of data symbols received from said antenna for each of the plurality of antennas.

46. The apparatus of claim 44, wherein said plurality of antennas comprises N antennas, and

further comprising:

means for receiving N-1 training symbols after the first training symbol.

47. The apparatus of claim 46, wherein each of the first and N-1 training symbols comprises the plurality of data symbols, and

wherein each of said training symbols has a corresponding pattern in which a different subset of the plurality of data symbols is transmitted on each of said plurality of antennas than in the other training symbols.

48. The apparatus of claim 47, further comprising:

means for receiving each of the plurality of data symbols from each of the plurality of antennas.

49. The apparatus of claim 48, wherein said means for determining comprises:

means for performing an inverse Fourier transform on the plurality of data symbols received from each of the plurality of antennas.

50. A computer program comprising:

transmitting a first training symbol on a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of the plurality of antennas transmits corresponding ones of the plurality of data symbols.

51. The computer program of claim 50, further comprising:

transmitting a second training symbol on the plurality of antennas,

wherein the second training symbol comprises the plurality of data symbols in the first training symbol, and

wherein each of the plurality of antennas transmits different ones of the plurality of data symbols than in the first training symbol.

52. The computer program of claim 51, wherein the first training symbol has a first pattern in which each of the plurality of antennas transmits one of a plurality of subsets of the plurality of data symbols, and

wherein the second training symbols has a second pattern comprising a shifted pattern of the first pattern such that each of the plurality of antennas transmits a different one of said plurality of subsets than in the first training symbol.

53. The computer program of claim 50, wherein the plurality of antennas comprises N antennas, and further comprising transmitting N-1 training symbols after the first training symbol.

54. The computer program of claim 53, further comprising:

transmitting each of said training symbols at least two times.

55. The computer program of claim 50, further comprising:

transmitting the first training symbol at least two times.

56. The computer program of claim 50, wherein the plurality of data symbols in the first training symbol are transmitted simultaneously on the plurality of antennas.

57. The computer program of claim 50, wherein each of the plurality of antennas transmits said corresponding ones of the plurality of data symbols on corresponding ones of the plurality of tones and transmits null symbols on the other tones.

58. The computer program of claim 50, wherein the first training symbol comprises an OFDM (Orthogonal Frequency Division Multiplexing) training symbol.

59. A computer program comprising:

receiving a first training symbol transmitted by a plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of a plurality of subsets of the plurality of data symbols is received from a corresponding one of the plurality of antennas; and

in response to at least the first training symbol, determining a gain at each of the plurality of antennas for each of the plurality of tones.

60. The computer program of claim 59, wherein said determining comprises:

for each of the plurality of antennas, interpolating values for a plurality of said tones from the corresponding subset of the plurality of data symbols received from said antenna.

61. The computer program of claim 59, wherein said plurality of antennas comprises N antennas, and

further comprising:

receiving N-1 training symbols after the first training symbol.

62. The computer program of claim 61, wherein each of the first and N-1 training symbols comprises the plurality of data symbols, and

wherein each of said training symbols has a corresponding pattern in which a different subset of the plurality of data symbols is transmitted on each of said plurality of antennas than in the other training symbols.

63. The computer program of claim 62, further comprising:

receiving each of the plurality of data symbols from each of the plurality of antennas.

64. The computer program of claim 63, wherein said determining comprises:

performing an inverse Fourier transform on the plurality of data symbols received from each of the plurality of antennas.

65. A system comprising:

a first transceiver comprising

a first plurality of antennas, and

a transmit training module operative to transmit a first training symbol on the first plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of the first plurality of antennas transmits corresponding ones of the plurality of data symbols; and

a second transceiver comprising

a second plurality of antennas, and

a receive training module operative to receive the first training symbol and to determine a gain at each of the first plurality of antennas for each of the plurality of tones in response to at least the first training symbol.

66. The system of claim 65, wherein the transmit training module is further operative to transmit a second training symbol on the first plurality of antennas,

wherein the second training symbol comprises the plurality of data symbols in the first training symbol, and

wherein each of the plurality of first antennas transmits different ones of the plurality of data symbols than in the first training symbol.

67. The system of claim 66, wherein the first training symbol has a first pattern in which each of the first plurality of antennas transmits one of a plurality of subsets of the plurality of data symbols, and

wherein the second training symbol has a second pattern comprising a shifted pattern of the first pattern such that each of the first plurality of antennas transmits a different one of said plurality of subsets than in the first training symbol.

68. The system of claim 65, wherein the plurality of antennas comprise N antennas, and wherein the transmit training module is further operative to transmit N-1 training symbols after the first training symbol.

69. The system of claim 68, wherein each of the first and N-1 training symbols comprises the plurality of data symbols, and

wherein each of said training symbols has a corresponding pattern in which a different subset of the plurality of data symbols is transmitted on each of said first plurality of antennas than in the other training symbols.

70. The system of claim 69, wherein the receive training module is further operative to receive each of the plurality of data symbols from each of the plurality of antennas.

71. The system of claim 70, wherein the receive training module is further operative to perform an inverse Fourier transform on the plurality of data symbols received from each of the plurality of antennas.

72. The system of claim 65, wherein the system comprises an N X N multiple-in-multiple-out (MIMO) system.

73. The system of claim 65, wherein the first training symbol comprises an OFDM (Orthogonal Frequency Division Multiplexing) training symbol.

74. A system comprising:

a first transceiver comprising

a first plurality of antennas, and

means for transmitting a first training symbol on the first plurality of antennas,

wherein the first training symbol comprises a plurality of data symbols,

wherein each of the plurality of data symbols corresponds to one of a plurality of tones, and

wherein each of the first plurality of antennas transmits corresponding ones of the plurality of data symbols; and

a second transceiver comprising

a second plurality of antennas,

means for receiving the first training symbol, and

means for determining a gain at each of the first plurality of antennas for each of the plurality of tones in response to at least the first training symbol.

75. The system of claim 74, wherein the first transceiver further comprises means for transmitting a second training symbol on the first plurality of antennas,

wherein the second training symbol comprises the plurality of data symbols in the first training symbol, and

wherein each of the plurality of first antennas transmits different ones of the plurality of data symbols than in the first training symbol.

76. The system of claim 75, wherein the first training symbol has a first pattern in which each of the first plurality of antennas transmits one of a plurality of subsets of the plurality of data symbols, and

wherein the second training symbol has a second pattern comprising a shifted pattern of the first pattern such that each of the first plurality of antennas transmits a different one of said plurality of subsets than in the first training symbol.

77. The system of claim 74, wherein the plurality of antennas comprise N antennas, and wherein the first transceiver further comprises means for transmitting N-1 training symbols after the first training symbol.

78. The system of claim 77, wherein each of the first and N-1 training symbols comprises the plurality of data symbols, and

wherein each of said training symbols has a corresponding pattern in which a different subset of the plurality of data symbols is transmitted on each of said first plurality of antennas than in the other training symbols.

79. The system of claim 78, wherein the second transceiver further comprises means for receiving each of the plurality of data symbols from each of the plurality of antennas.

80. The system of claim 79, wherein the second transceiver further comprises means for performing an inverse Fourier transform on the plurality of data symbols received from each of the plurality of antennas.

81. The system of claim 74, wherein the system comprises an N X N multiple-in-multiple-out (MIMO) system.

82. The system of claim 74, wherein the first training symbol comprises an OFDM (Orthogonal Frequency Division Multiplexing) training symbol.